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Preparation of Silver-Activated Zinc Sulfide Thin Films

The problem:

To form thin films of silver-activated zinc sulfide with improved luminescence and reduced contamination.

When zinc sulfide phosphors are deposited as thin films by vacuum evaporation followed by calcining, the product has poor luminescent properties due to loss of activator and contamination.

The solution:

Additional silver is introduced in the film after deposition but before calcining, by immersion in a solution of a silver salt. The film is then calcined while in contact with and surrounded by the phosphor powder, to which has been added a small quantity of sodium chloride. This firing procedure protects the film from contamination, particularly oxidation, during firing, and introduces more silver activator and chlorine coactivator.

How it's done:

Commercial silver-activated zinc sulfide (P11) phosphor is vacuum-deposited on a quartz or low-expansion glass substrate to a thickness of 0.3 to 3 microns. The phosphor-coated substrate is then immersed in an ammoniacal solution of silver nitrate to which some alcohol has been added. A thin film of silver sulfide is formed on the surface of the zinc sulfide in accordance with the following equation:

$$\text{ZnS} + 2\text{Ag}^+ \rightarrow \text{Ag}_2\text{S} + \text{Zn}^{++}$$

The film on the substrate is then rinsed and dried, and the unit is placed in contact in a dish with more

P11 phosphor, to which has been added a few crystals of sodium chloride, so that the substrate and film are completely immersed in the phosphor powder. The dish is then covered and placed in a furnace at about 850°C for 15 to 30 minutes. At the end of this period, the dish is taken from the oven, and allowed to cool nearly to room temperature. The coated substrate is then removed from the oven, and any adhering powder is blown or brushed off. Films formed in this way show good response to protons and other types of radiation such as cathode rays. Films thinner than about 0.5 micron are usually transparent, but thicker films tend to be hazy, which, however, does not impair their utility for many purposes.

Note:

Technical details may be obtained from:
Technology Utilization Officer
Goddard Space Flight Center
Greenbelt, Maryland 20771
Reference: B68-10271

Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to NASA, Code GP, Washington, D.C. 20546.

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